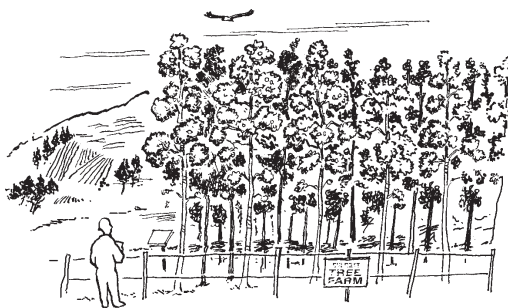




Biomass Energy



EPA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

Energy from Plants

The term *biomass* refers to renewable organic matter. Examples of biomass include fast-growing trees and plants, wood and wood waste, agricultural crops and residues, aquatic plants and algae, animal wastes, and organic municipal and industrial wastes. Humans have relied on biomass energy throughout history, but fossil fuels such as coal, petroleum, and natural gas have largely replaced biomass as the major source of energy in industrialized countries.

Today, environmental and economic concerns have created many new opportunities for the use of biomass energy. Biomass can play an important role in reducing greenhouse gas emissions and air pollution. It also can help the nation reduce its dependence on imported oil, which accounts for about half the oil consumed in the United States.

A comprehensive program of growing “energy crops”—fast-growing trees, perennial grasses, aquatic plants, and algae—may reduce net greenhouse gas emissions if biomass is used in place of fossil fuels. Each new generation of energy crops will, as it grows, remove from the atmosphere through photosynthesis a quantity of CO₂ roughly equivalent to that released when the biomass is converted to fuel and burned to release energy. If sustainably managed energy crops supplant energy that otherwise would be generated by fossil fuels, net CO₂ emissions may decrease. Energy crops must be grown using best practices that minimize the life-cycle greenhouse gas emissions associated with planting, growing, harvesting, transporting, and converting the crops into usable energy.

Greenhouse gas emissions also can be reduced by displacing fossil fuel use with energy from biomass residues. Biomass residues include agricultural wastes, food processing wastes, and a wide variety of woody waste materials. Residues from the wood products and forestry industries are the largest source of biomass available today for energy, supplying about 64 percent of the total used in the United States.

Another strategy for reducing greenhouse gas emissions with biomass energy involves the capture and use of landfill methane, which is generated by the bacterial decomposition of organic materials in landfills. Landfills are the single largest human source of methane emissions in the United States.

Biomass can be converted into energy in a variety of ways. It can be burned to provide space heat. Starch and cellulose in plants can be converted into ethanol for transportation fuels. Vegetable oils can be combined with related fatty acid biomass feedstocks, an alcohol, and a catalyzing agent to produce biodiesel, a cleaner-burning fuel for compression-ignition engines. Biomass also can be used to generate electricity, either alone or along with coal in traditional power plants, a process known as co-firing.

Advances in technology have made it possible to convert biomass into a combustible oil or gas by heating it in anaerobic (oxygen-free) conditions. Gasifying biomass to produce electricity is up to twice as efficient as burning it directly and results in lower greenhouse gas emissions.

In the United States, biomass sources supply nearly 4 percent of all energy consumed. Biomass is used to generate more than 7,500 megawatts of electricity in the U.S., enough to power several million homes. About 1.2 billion gallons of ethanol are used in the U.S. as a blend in gasoline.

The Federal Role

The U.S. Department of Energy's National Biofuels Program is developing new technologies that can convert a broad range of low-cost cellulosic biomass into ethanol, such as wood or grass, as well as sugar cane bagasse and rice straw.

DOE's Biopower Program focuses on developing biomass-based electricity generation systems using advanced combustion technologies, co-firing, gasification, and small, modular systems. It also helps fund the development of sustainable energy crops.

DOE's Regional Biomass Energy Program was established in 1983 to help increase the production and use of biomass for energy. The program's five regional offices provide cost-sharing and other support to improve the capabilities and effectiveness of industry and state and local government in the production and use of biomass energy resources.

The federal AgStar program, run jointly by EPA, DOE, and the U.S. Department of Agriculture, works with livestock farmers to capture biogas from animal waste for on-farm energy. EPA's Landfill Methane Outreach Program helps landfill owners and operators find profitable ways to capture energy from landfill gas.

An executive order issued in August 1999 calls for tripling U.S. use of bioenergy and bio-based products (such as pharmaceuticals and chemical feedstocks) by 2010. In addition, the federal government has established a biomass energy tax credit of 1.5 cents per kilowatt-hour for the production of electricity from biomass energy crops. The administration has proposed to expand the credit to apply to certain waste materials, such as mill residues, waste pallets, tree trimmings, and orchard crops, and it would offer a credit of 1.0 cent per kilowatt-hour to biomass that is co-fired in coal plants.

State Experiences with Biomass Energy

Biomass is used in many states for space heating, electricity production, cogeneration of heat and power, and transportation fuels.

Vermont

The McNeil Generating Station in Burlington, Vermont, was built in 1984 to burn wood or natural gas—whichever is cheaper—to produce electricity for the power grid. Currently McNeil burns wood: 85 percent forest residue, 10-15 percent mill waste, and a small amount from pallets and yard waste, at a capacity of 15 megawatts. McNeil is allowed to burn only untreated wood, and it has a sustainable harvesting program. A demonstration biomass gasifier connected to the McNeil

Generating Station is considered key in the development of large, industrial- and utility-scale gasifiers.

The Burlington Electric Department proposes to capture steam or hot water from the McNeil station and pipe it to buildings on the campus of the University of Vermont, nearby Fletcher Allen Hospital, and eventually the entire city of Burlington for space and water heating.

If both the university and the hospital used McNeil's biomass energy, carbon dioxide emissions could be reduced by 30,000 tons per year. After the initial investment, the university could save \$100,000 per year in fuel costs and the hospital \$50,000. If the entire community of Burlington were included in the district heating system, CO₂ emissions could be reduced to an annual total of just 50,000 tons, compared with 732,000 tons emitted by the city in 1997.

Ohio

In 1996, the State of Ohio added 10 flexible-fuel sedans to its fleet in order to demonstrate ethanol's effectiveness as an alternative to gasoline. Flexible-fuel vehicles can operate on gasoline, E85 (a blend of 85 percent ethanol and 15 percent gasoline), or any blend of the two fuels that does not exceed 85 percent ethanol. Assuming best practices that minimize life-cycle greenhouse gas emissions, alternative fueled vehicles such as these can help reduce greenhouse gas emissions from the transportation sector.

State administrators set up two E85 fueling sites in the metropolitan Columbus area during the demonstration. The flexible-fuel sedans were driven an average of slightly more than 1,100 miles per month and performed as well as the fleet's gasoline vehicles. Operating costs were higher due to the higher price of E85, but the flexible fuel vehicles had lower NO_x and CO₂ emissions than those of standard gasoline vehicles.

Based on the demonstration's success, Ohio added more than 200 flexible-fuel vehicles to its fleet in 1997 and more than 300 in 1998. The state also is continuing to expand its E85 fueling infrastructure.

For More Information

The U.S. Department of Energy's *Energy Efficiency and Renewable Energy Network* provides information on biomass power.

Website: <http://www.eren.doe.gov/biopower>

DOE's *Biofuels Program* develops clean biomass-based fuels for transportation.

Website: <http://www.ott.doe.gov/biofuels/biofuels.html>

DOE's *Regional Biomass Energy Program* provides cost-sharing and other support to states, local governments, and industry.

Website: <http://rredc.nrel.gov/biomass/doe/rbep/>

The *American Bioenergy Association* provides information on legislative and regulatory initiatives.

Tel: 202-639-0384

Website <http://www.biomass.org>

EPA's *State and Local Climate Change Program* helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while they address other environmental problems.

Website: <http://www.epa.gov/globalwarming/> and click on

"Public Decision Makers" under the "Visitors Center."

BENEFITS OF BIOMASS ENERGY

- Renewable and recyclable energy source ("stored solar energy").
- Less waste directed to landfills.
- Decreased reliance on imported energy sources.
- Potential rural development and job creation.
- Can generate renewable electricity when the sun isn't shining and the wind isn't blowing.
- Potential for low net carbon dioxide emissions if trees and crops are harvested sustainably, allowing rapid new growth to recycle carbon.